Understanding the Mobile Source Contribution to Ambient Hot Spots

National Training Workshop on Local Urban Air Toxics
Assessment and Reduction Strategies
Detroit, Michigan
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What is NESCAUM?

The Northeast States for Coordinated Air Use Management (NESCAUM) is a multi-state organization representing the eight Northeastern States (New England, New York, and New Jersey).

NESCAUM was established in October 1967 by the Northeast Conference of State Public Health Officials at the behest of the New England Governors' Conference.

NESCAUM's mission is to work collaboratively on the challenging technical and policy issues facing its member states.

NESCAUM's Recent Mobile Source Work

- 1998-2001 Reviewing national-scale modeling results and ambient air monitoring results across the Northeast region to better prioritized regulatory and voluntary emission reduction programs for toxic air pollutants

- 1999 Published a technical summary of the policy options regarding reformulated fuels containing M*t*BE

- 1999 Submitted technical peer review comments on the USEPA's evaluation of exposure to toxic air pollutants generated by mobile sources and their fuels

- 2001 Published a technical summary of the policy options regarding reformulated fuels containing ethanol in reformulated gasoline

Questions for the day...

- What is a "hotspot" when evaluating mobile sources and their fuels?

- What are several pervasive air quality issues in the Northeast (the United States) how important are the emissions of mobile sources to these challenges?

- What are the strengths and limitations associated with current tools?

- What are some future research needs?

Examples of "Hotspots"

- Refinery Processing
  - Nearby residents
  - Occupational exposures.

- Fuel Distribution
  - Refueling;
  - Occupational exposures; and
  - Nearby residents.

- Mobile Sources
  - Residents near roadways (urban and rural);
  - Urban residents (higher background and near roadways);
  - Construction sites (occupational/residential); and
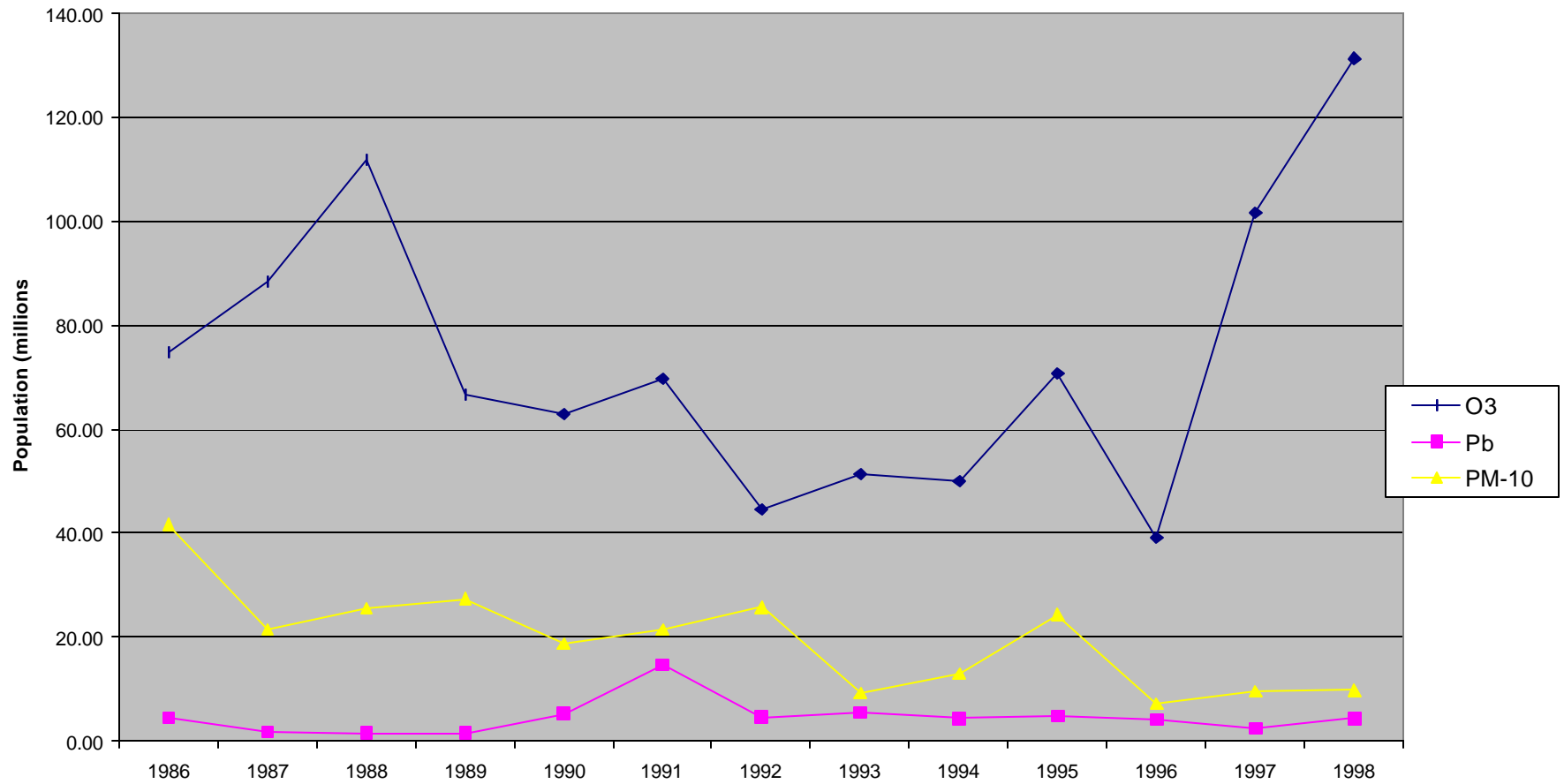 - Mass transit terminals/bus depots (urban and rural).

"Bad" Air Quality

- Ozone
- Carbon Monoxide
- Hazardous Air Pollutants
- Particulate Matter
- Lead
- Nitrogen Dioxide
- Sulfur Dioxide

Number of People Living in Non-Attainment Areas (Counties)

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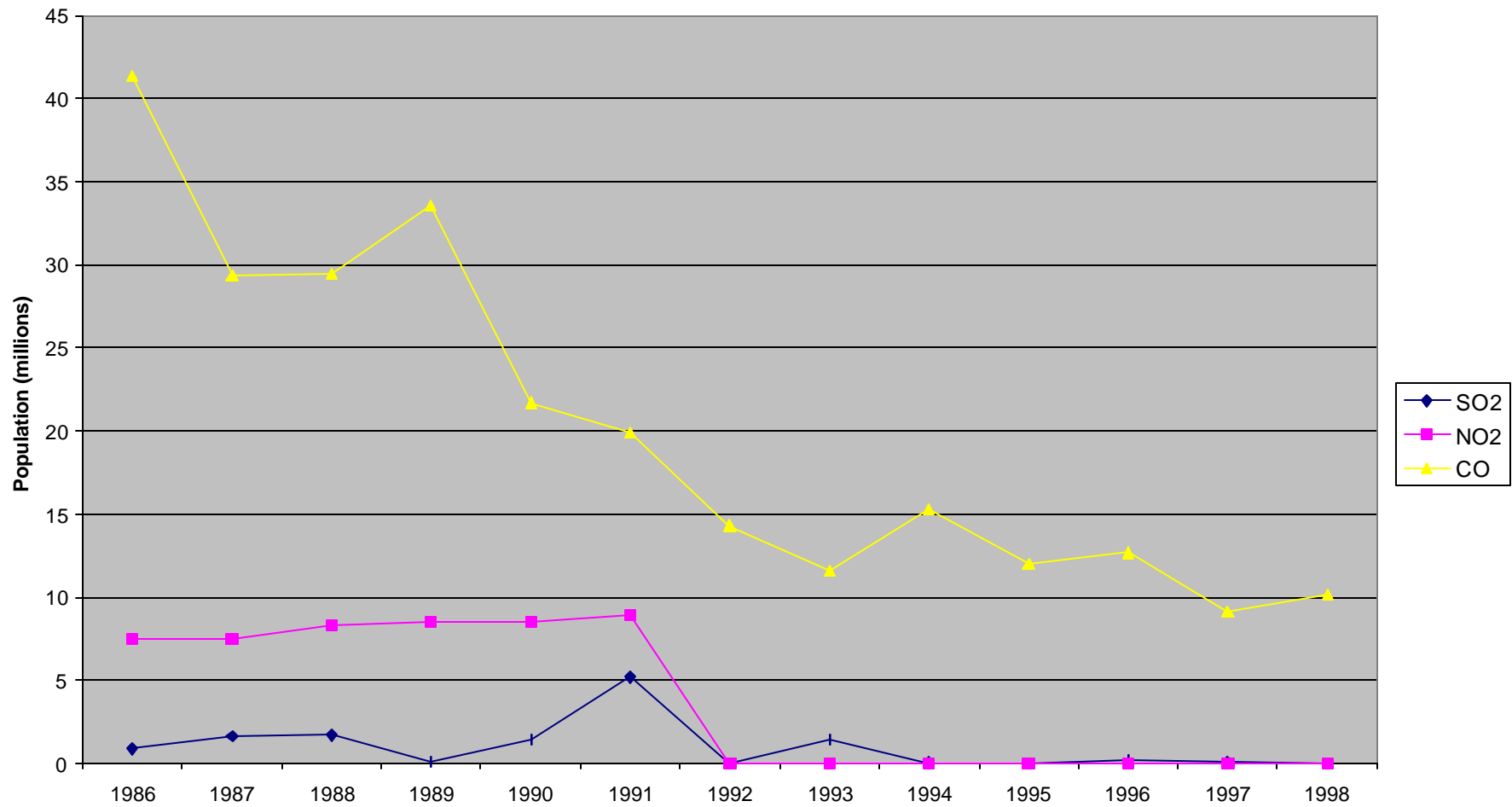
Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, National Air Quality and Trends Report, 1998.
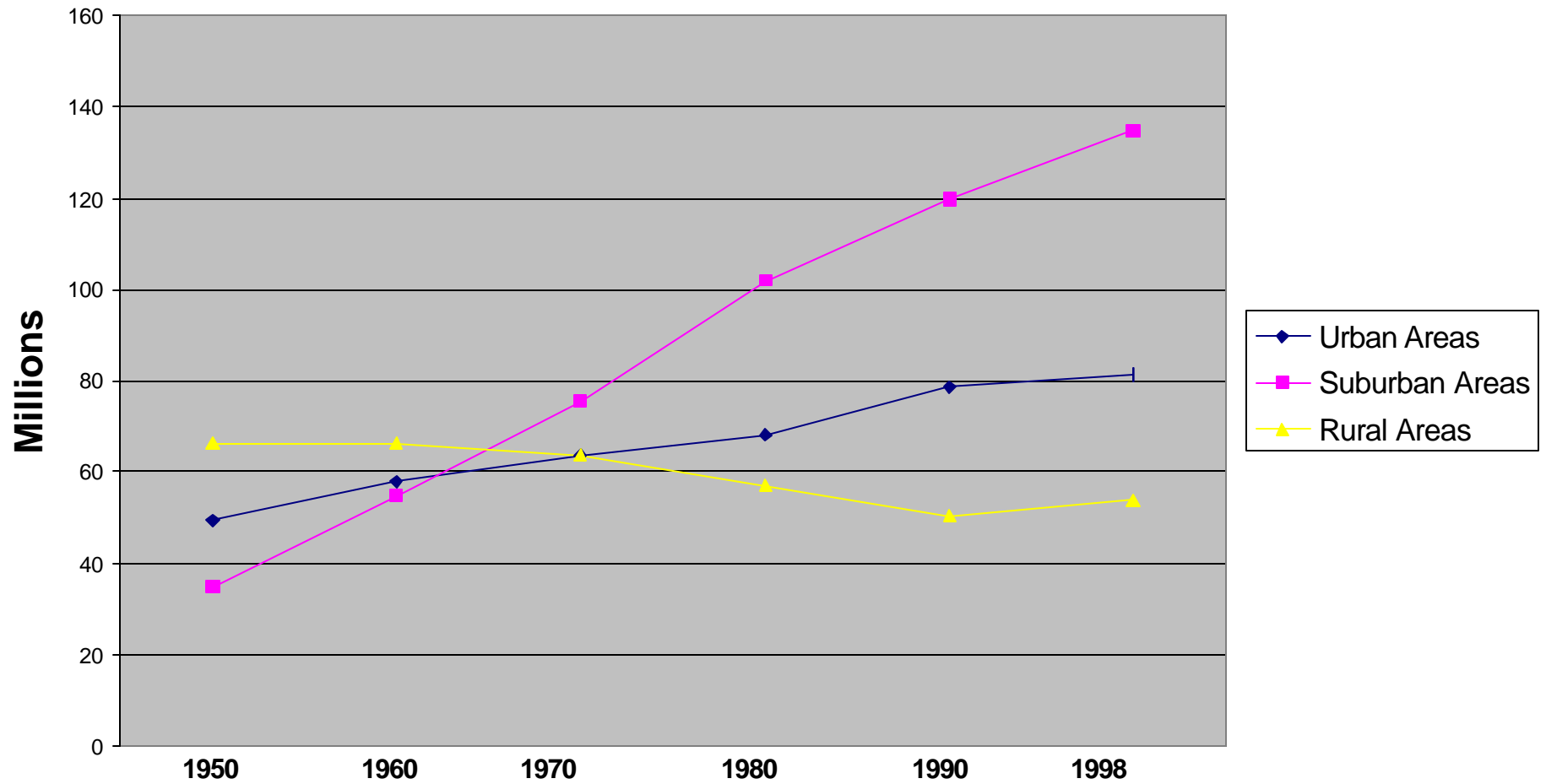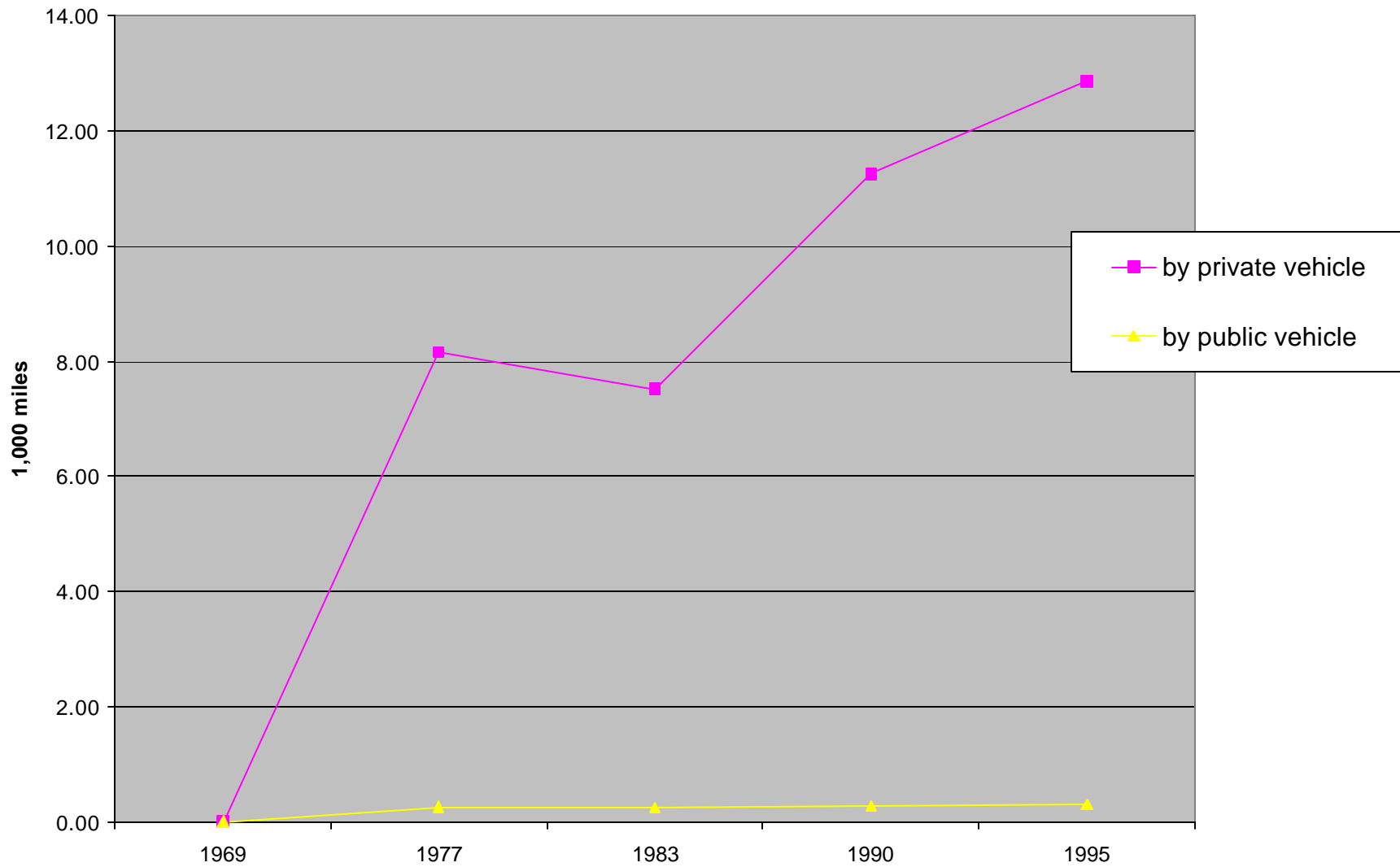
U.S. Population in Urban, Suburban, and Rural Areas (1950-1998)

Source: U.S. Department of Commerce, Bureau of the Census, Census of Population and Housing, 1999.
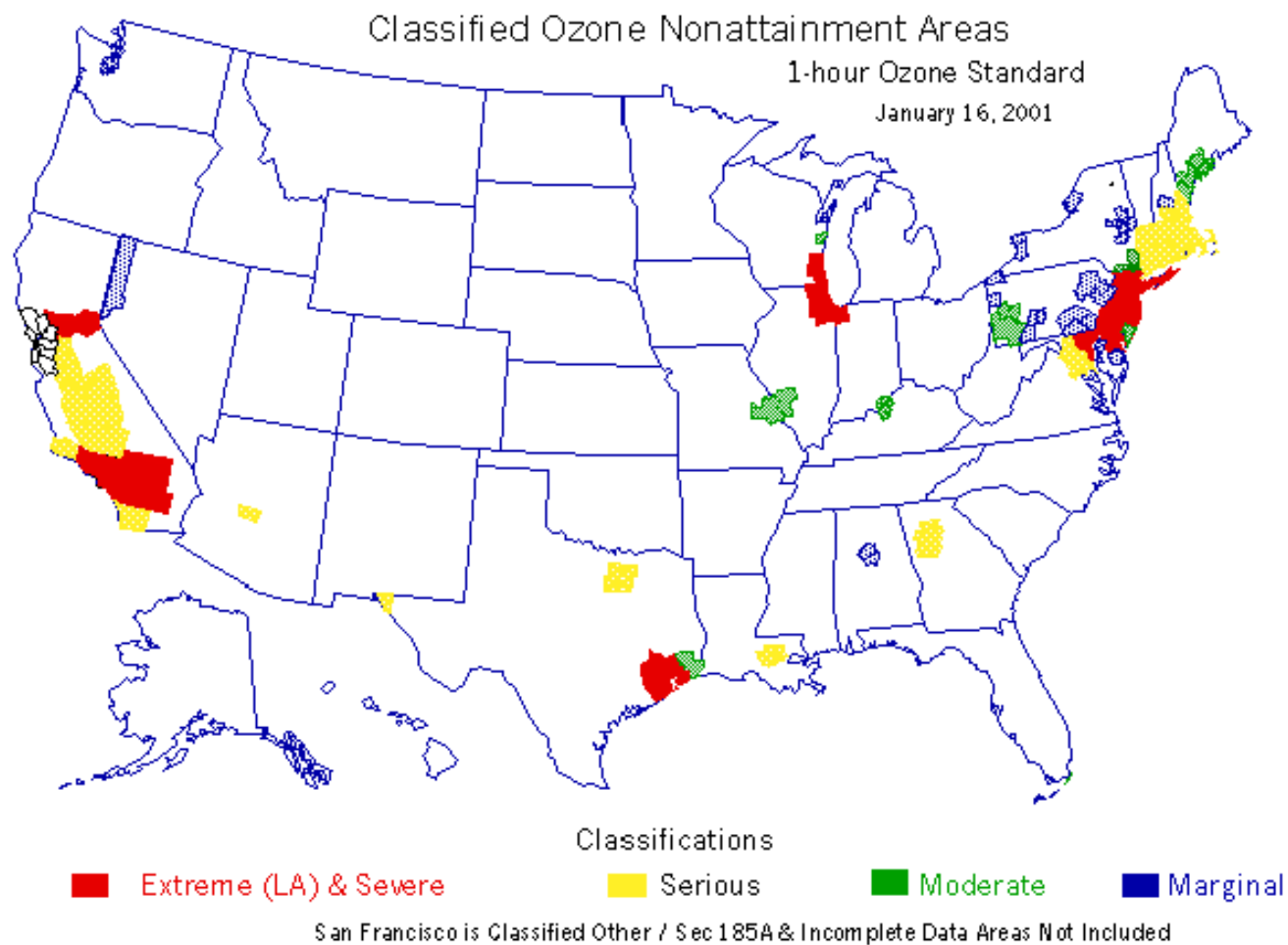
U.S. Average Annual Personal Travel

Source: Hu, P.A. and J.R. Young, Summary of Travel Trends 1995 Natonwide Personal Transportation Survey

Motor vehicles in the Northeast:

- emit 1/3 smog forming volatile organic compounds and oxides of nitrogen in the region (2/3 if include non-road vehicles)

- are the primary source of carbon monoxide

Classified Ozone Nonattainment Areas
1-hour Ozone Standard
January 16, 2001

Classifications

■ Extreme (LA) & Severe   ■ Serious   ■ Moderate   ■ Marginal

San Francisco is Classified Other / Sec 185A & Incomplete Data Areas Not Included

Source: USEPA, OAR Greenbook, Feb. 2001

Studies conducted in the Northeastern United States and Canada that show that ozone air pollution may be associated with 10-20 percent of all of the summertime respiratory-related hospital admissions.

US Environmental Protection Agency, Criteria Document in support of proposed 8-hour ozone standard

Hazardous Air Pollutants

- Non-cancer effects:
    - Respiratory Damage
    - other non-cancer health impacts of concern

- Cancer effects
    - Known and probable human carcinogens

US EPA and HAP Assessments

- The Cumulative Exposure Project-1990.
  - Computer dispersion modeling,
  - Ambient monitoring assessment.

- National Air Toxics Assessment-1996.
  - Computer dispersion modeling,
  - Exposure modeling,
  - Ambient monitoring assessment.

- Integrated Urban Air Toxics strategy (112(k)).
  - 33 priority pollutants,
  - Focus on point, area, and mobile source emissions and risk reduction in urban areas.

- Technical Analyses to support rulemaking under 202(l)
  - 21 priority mobile source pollutants;
  - estimated exposure in several urban areas.

National results of CEP and National Scale Assessment

- In 1990, predicted that all Americans were exposed to ambient concentrations of seven hazardous air pollutants concentrations above health benchmark values (cancer)

- In 1996, millions of Americans were estimated to be exposed to hazardous air pollutant concentrations above health benchmark values (cancer)

- Mobile sources a major emissions contributor to these risk estimates in both studies.

CEP and National Scale Assessment

Strengths:
- National scale evaluations--*great for screening*;
- Supported prioritization using a risk-based approach;
- Evaluated 148 and 33 priority toxic compounds, respectively;
- Considered multiple emission sources;
- Modeled ambient concentrations and exposures

Limitations:
- Emissions inventory and modeling assumptions have significant impact on predictions,
- Dispersion model limitations--*not great for "hotspots,"*
- Little validation of exposure modeling estimates;
- Do not consider risk impacts of cumulative exposure to mixtures of these pollutants in the same air shed,
- May not have considered some important pollutants.

List of the 33 Urban Air Toxics

|	
acetaldehyde	ethylene oxide
acrolein	formaldehyde
acrylonitrile	hexachlorobenzene
arsenic compounds	hydrazine
benzene	lead compounds
beryllium compounds	manganese compounds
1, 3-butadiene	mercury compounds
cadmium compounds	methylene chloride
carbon tetrachloride	nickel compounds
chloroform	polychlorinated biphenyls (PCBs)
chromium compounds	polycyclic organic matter (POM)
coke oven emissions	quinoline
Dioxin/furans	1, 1, 2, 2-tetrachloroethane
ethylene dibromide	perchloroethylene
propylene dichloride	trichloroethylene
1, 3-dichloropropene	vinyl chloride
ethylene dichloride	--

Reference: US EPA, final Integrated Urban Air Toxics Strategy, July 19, 1999

202(l) also identifies: diesel particulate matter, diesel exhaust organic gases, n-hexane, ethyl benzene, naphthalene, styrene, toluene, xylene.
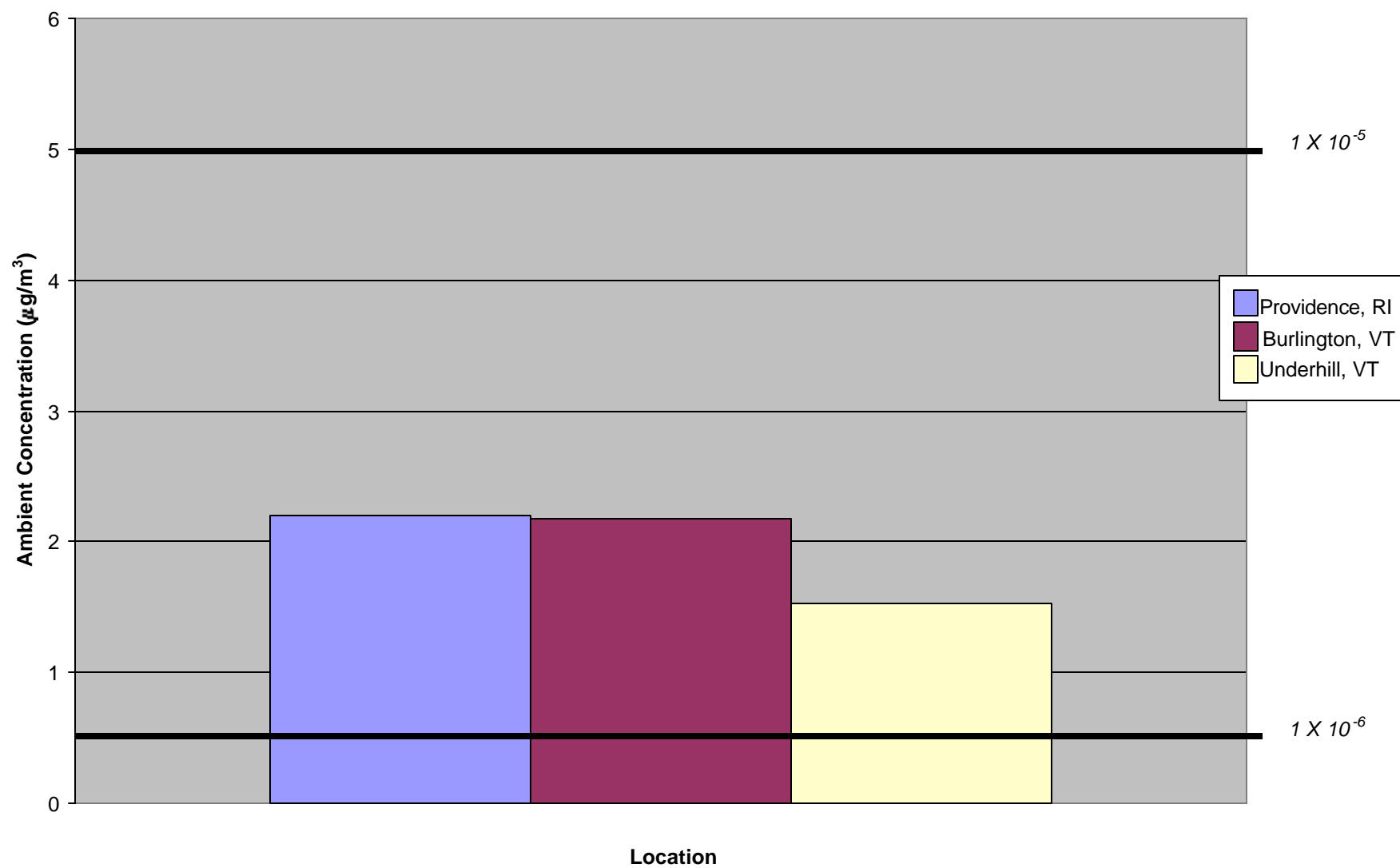
Northeastern States' HAP Assessments

- Ambient monitoring results review

- Qualification of exposure and risk concerns

- Emissions inventory review and expansion (particularly for 1996 national toxics inventory)

- Evaluation of dispersion modeling tools
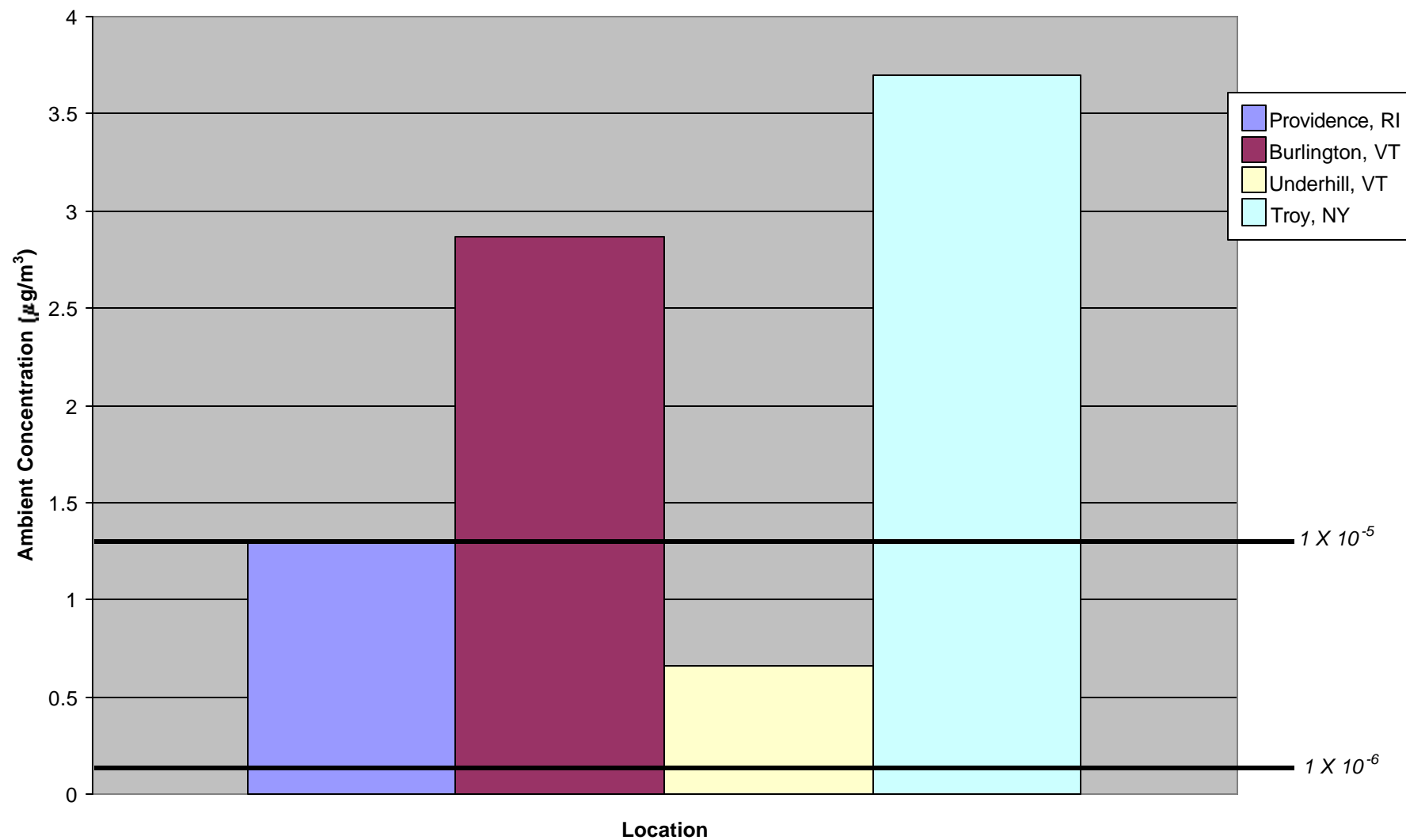
- Developing strategies to assess "hotspots"

Vermont Ambient Monitoring Data, 1994
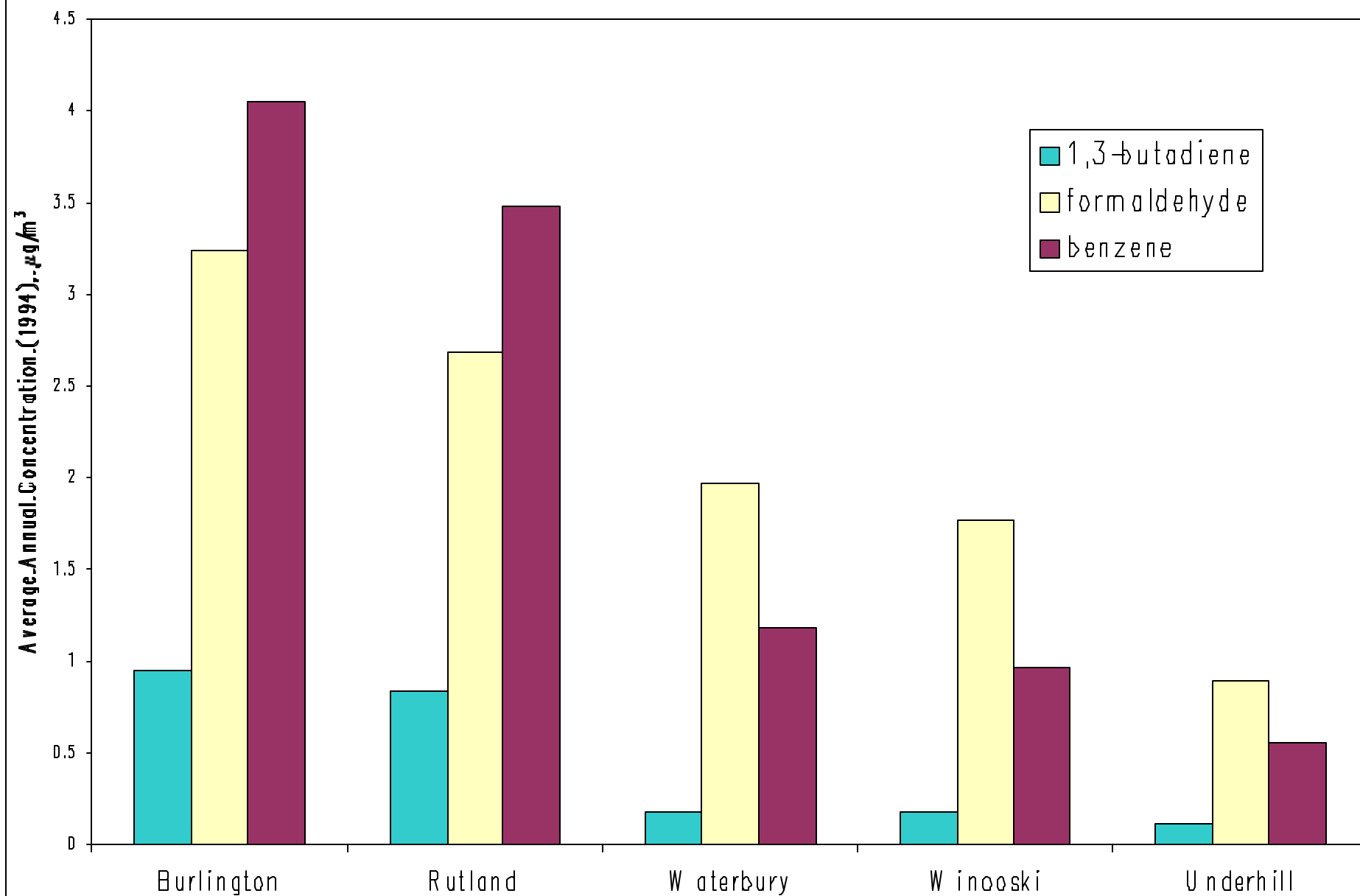
1997 Acetaldehyde Annual Average Ambient Concentrations

1997 Benzene Annual Average Ambient Concentration

Y-axis: Ambient Concentration ($\mu g/m^3$)

X-axis: Location

Legend:
- Providence, RI
- Burlington, VT
- Underhill, VT
- Troy, NY

Reference lines: 1×10^{-5}, 1×10^{-6}

1997 1,3-Butadiene Annual Average Ambient Concentration

Ambient Concentrations (μg/m³)

0.35
0.3
0.25
0.2
0.15
0.1
0.05
0

Providence, RI
Burlington, VT
Underhill, VT

1×10^{-5}

1×10^{-6}

Location
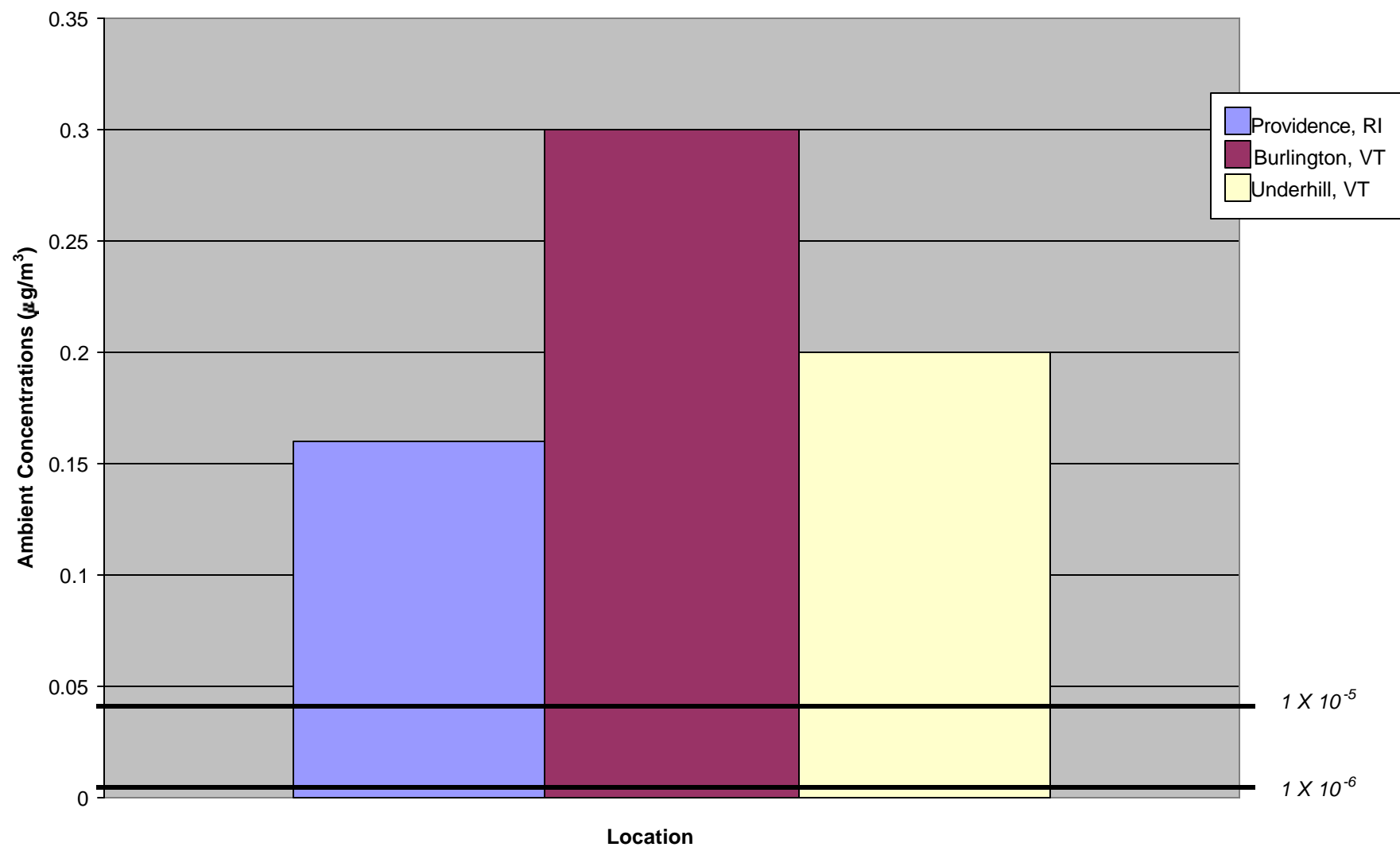
1997 Formaldehyde Annual Average Ambient Concentrations

Chart — Y-axis: Ambient Concentration ($\mu g/m^3$); X-axis: Location

Legend:
- Providence, RI
- Burlington, VT
- Underhill, VT

Reference lines: 1×10^{-5}, 1×10^{-6}
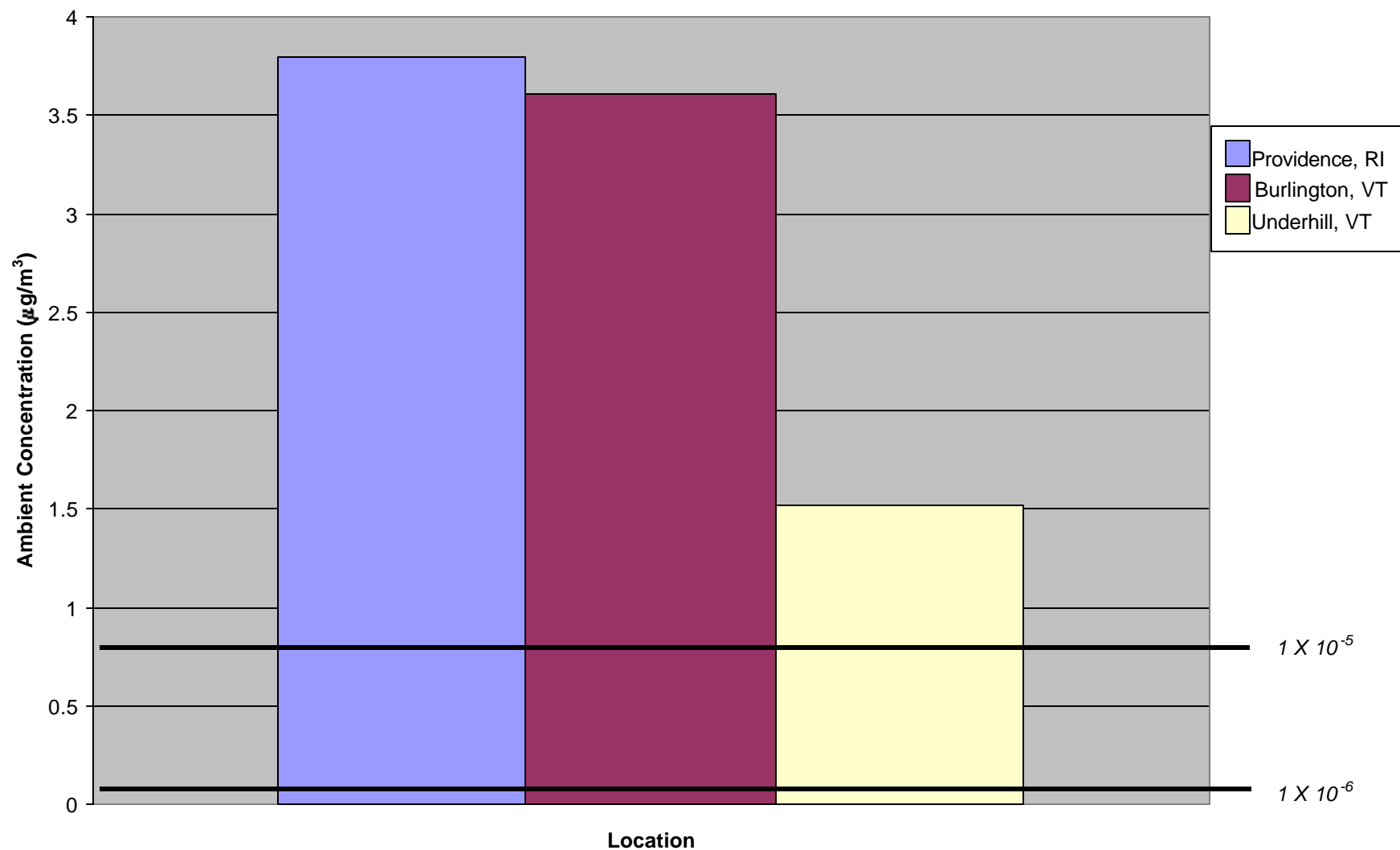
State ambient monitoring efforts

Strengths:
- Monitoring ambient average concentrations across the region for numerous hazardous air pollutants.
- Results demonstrate common challenges as well as urban - rural differences.
- The collaborative effort to critically evaluate and improve the monitoring network in this region will strengthen future characterization.

Limitations:
- Not possible (cost-effective) to monitor everywhere.
- Annual average concentrations will not support non-cancer health impact assessments.
- Current network doesn't typically consider "hot spots" of potential exposure.

Northeastern States' HAP Assessments

- Emissions inventory review and expansion (particularly for 1996 national toxics inventory)

- Evaluation of dispersion modeling tools

1996 Percentage of Regional Emissions Inventory for Several Priority Compounds
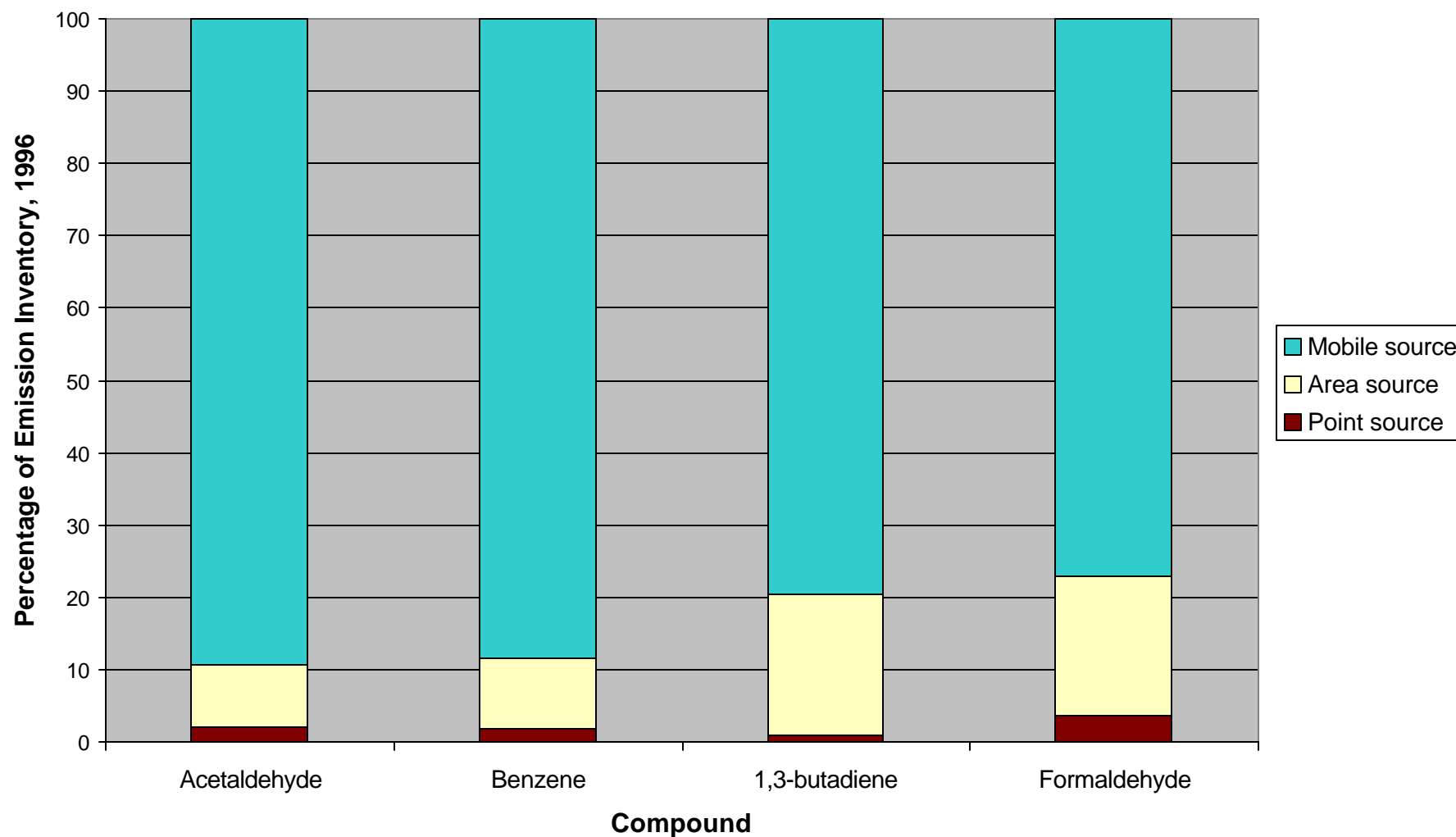
Future needs:

- Improved tools to estimate the magnitude and variability of exposure/risk estimates across a study population.

Quantify the exposure and risks associated for population groups:
1. With closer proximity to higher motor vehicle density (urban roadways).
2. With exposure to temporal/seasonal peaks in pollutant concentrations (important for non-cancer assessments).

 Enhance exposure estimation models to more accurately consider demographic group variability and sensitive sub-populations of   potential importance.

Enhance the understanding of the total exposure for populations moving through various microenvironments.

NESCAUM's ongoing Mobile Source Work

- Expanding emissions inventory development

- Expanding / targeting ambient monitoring work

- Monitoring air quality in and around public school buildings

- Monitoring "real time" exposure to diesel PM

- Developing a research effort to qualify and quantify ambient impact and "high-end" exposures to mobile source emissions from the non-road sector

- Evaluating voluntary emissions control options

School and School bus study

Goal: to expand our understanding of microenvironmental exposure and ambient air toxic infiltration in 9 schools across New England.

- Monitoring daily average concentrations of:
    - carbonyls (4 hour average as well)
    - volatile organic compounds

- Monitoring real-time concentrations of:
    - carbon monoxide,
    - carbon dioxide,
    - particulate matter (PM2.5),
    - ozone,
    - sulfur dioxide,
    - nitrogen dioxide.

Future goals:

- Improve the integration of monitoring networks with dispersion and exposure modeling tools.

- Validate exposure modeling results.

- Develop tools to qualify and quantify the health risk associated with exposure to mixtures of these pollutants in the same air shed.

- Enhance communication and collaboration.